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Tailoring Graphene Morphology and Orientation on Cu(100), Cu(110), and Cu(111) ROBERT JACOBBERGER, MICHAEL ARNOLD, University of Wisconsin-Madison — Graphene CVD on Cu is phenomenologically complex, yielding diverse crystal morphologies, such as lobes, dendrites, stars, and hexagons, of various orientations. We present a comprehensive study of the evolution of these morphologies as a function of Cu surface orientation, pressure, H_2:CH_4, and nucleation density. Growth was studied on ultra-smooth, epitaxial Cu films inside Cu enclosures to minimize factors that normally complicate growth. With low H_2:CH_4, Mullins-Sekerka instabilities propagate to form dendrites, indicating transport limited growth. In LPCVD, the dendrites extend hundreds of microns in the 100, 111, and 110 directions on Cu(100), (110), and (111) and are perturbed by twin boundaries. In APCVD, multiple preferred dendrite orientations exist. With increasing H_2:CH_4, the dendritic nature of growth is suppressed. In LPCVD, square, rectangle, and hexagon crystals form on Cu(100), (110) and (111), reflecting the Cu crystallography. In APCVD, the morphology becomes hexagonal on each surface. If given ample time, every growth regime yields high-quality monolayers with D:G Raman ratio <0.1. The understanding gained here provides a framework to rationally tailor the graphene crystal morphology and orientation.

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